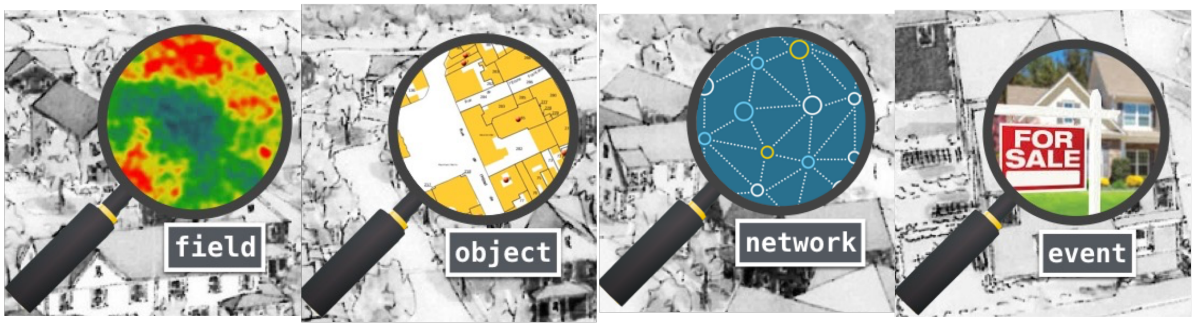
Spatial Data Modelling

How do we – as humans – perceive the world, and form cognitive models of reality?

World conceptualisations

People manipulate *objects* but cultivate *fields* @couclelis2005people

@kuhn2012core introduced the *Core concepts of Spatial Information* that goes beyond object and field (but hold on, under construction).



(a) Field (a) Object (a) Network (a) Event

Fields

Continuous scalar- or vector-valued phenomena that have a value definable for any location within the entire domain space.

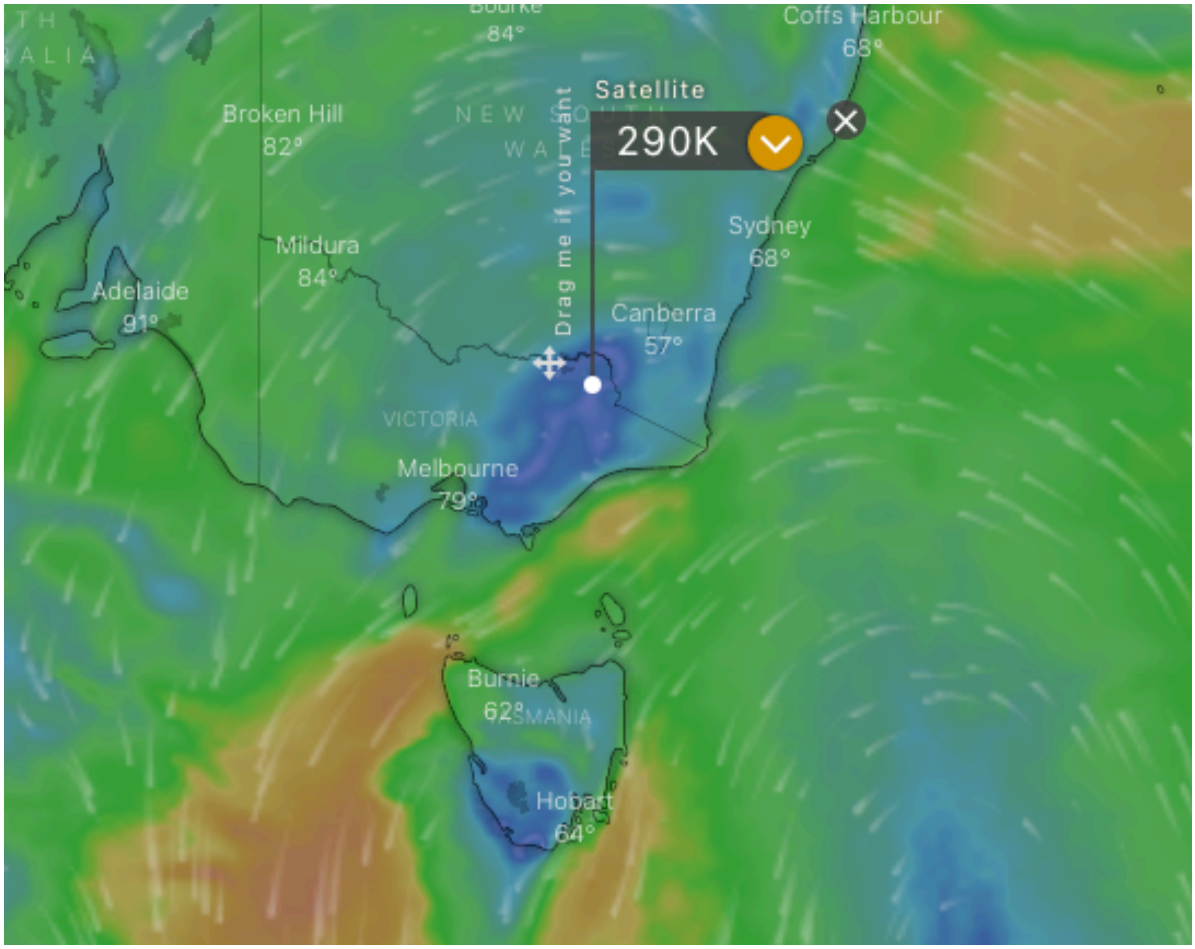


Figure 5: Wind and temperature

Answer to: What is the value of a phenomenon *here?*

Objects

- Discrete entities that populate space, but do not fill it;
- Preserve their identity and can be manipulated
- Are bounded, but the boundary is not necessarily *known*
- They can be made-up (*fiat*, based on thought) or *bona-fide* (genuine).
  - Victoria (spatial political entity) vs Tasmania (island)

Figure 6: Mug

Objects vs Fields

Exercise: Modelling choices

- What would you model as a field, and what as an object?
- What kind of objects are these?

Places

- Places are particular *types* of objects;
- They are locations enriched with meaning, by people, for people.
- A significant part of working with geospatial data, as we *refer* to places when we communicate!
- Often refered to by function (*home*), or toponym (place name) (*Naarm*, *Melbourne*).

Answer to: *Where am I?*

Networks and Events

- **Networks**: answer questions about connectivity. Emerge from relationships between objects.
  - *A power cable has been interrupted leading to an outage of electricity supply…*
- **Events:** Answer questions about change in locations, neighbourhoods, values of the above concepts.
  - *Flooding occured in Melbourne yesterday…*

Spatial relationships

Give rise to networks. Things relate in space in many ways, not only by *distance*.

- Qualitative spatial relationships: *near*, *nearer then*, *to the West of*, *touch*, *overlap*, *connecting to*, *between*
- Binary vs n-ary: the above are all binary (between two objects), except *connecting to* and *between*.

Distance

Tobler's first law: *"Everything is related to everything else, but near things are more related than distant things."* @tobler1970computer

Exercise: Describe patterns you see

How does distance alter what you expect to see/encounter?

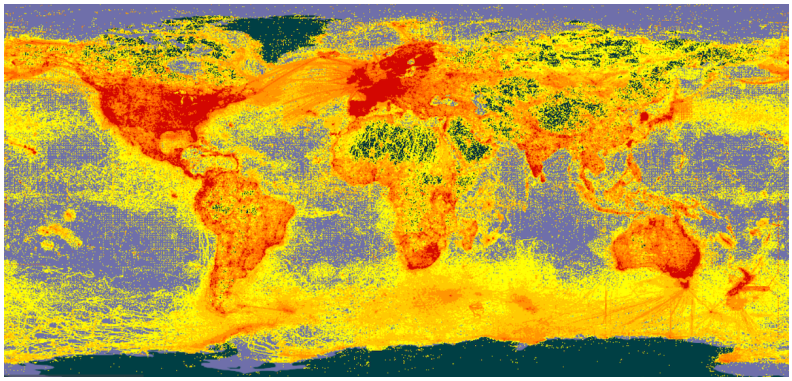


Figure 7: Image: gbif.org

More Geography principles

- **Corollary to the First law:** Spatial heterogeneity (Things are *not* the same everywhere)
- **Tobler's second law:** *"the phenomenon external to a geographic area of interest affects what goes on inside."*

- **Granularity/Precision:** The level of detail at which we represent a phenomenon alters the occlusions we can draw about the phenomenon. Closely relates to *scale* of analysis.
- **Accuracy**: Pertains to *correctness* of a value (attribute, position);
- **Provenance**: How (and when) the data came to be (how they were collected, processed, used)

Further impacts on data handling

- Boundaries of the area described by the data / map;
- The Modifiable Areal Unit Problem (MAUP)

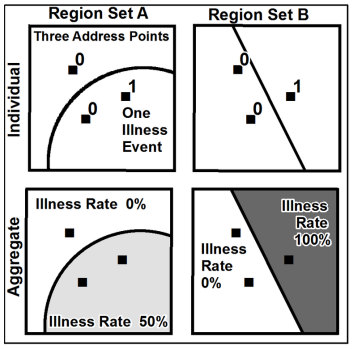


Figure 8: MAUP (wikipedia.com)

Exercise: How do the principles above apply here?

Discuss with neighbour how the boundary problem and scale may influence what we see.

Figure 9: Flood in QLD (Source: theconversation.com)

Spatial Information Systems